THE CUREE-CALTECH WOODFRAME PROJECT: EDUCATIONAL OUTREACH TO THE PUBLIC

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ABSTRACT:

The CUREE-Caltech Woodframe Project coordinates engineering investigations and implementation activities whose objective is to significantly reduce earthquake losses to woodframe construction. The project is divided into five interrelated elements, all integrated into one coordinated project. Testing and Analysis, Field Investigations, Building Codes and Standards, and Economic Aspects are the four investigative elements whose activities culminate at the end of calendar year 2002. Their results are documented and converted into a variety of products designed for a broad spectrum of end users. The author of this paper, who serves as Manager of Element 5, Education and Outreach, describes in more detail one of the most compelling products: "ShakeZone," a transportable earthquake education exhibit, designed as a community resource, a venue for educators, a place for students of all ages, a center for earthquake hazards education, and a replicable model for similar exhibits.

1. Introduction

The Earthquake Hazard Mitigation of Woodframe Construction project, or the CUREE-Caltech Woodframe Project, was launched in 1998 as a series of coordinated engineering investigations and implementation activities with the goal to significantly reduce earthquake losses to woodframe construction. This category of construction includes larger-size apartment and condominium buildings as well as houses; non-residential (e.g. school and commercial) as well as residential buildings; and both existing and new construction. The project was funded by the Federal Emergency Management Agency (FEMA) through a grant administered by the State of California Governors Office of Emergency Services (Reitherman, 1998.)

The idea for the project originated from the 1994 Northridge Earthquake, in which about half of the $40 billion property loss was incurred by woodframe construction. A significant portion of the public sector either lives or works in woodframe buildings (99% of the residences in California and 89% of United States residences are of woodframe construction), yet little research has previously focused on improving earthquake resistance. Woodframe Project Manager and Caltech Professor of Civil Engineering John Hall stated in 1998 that "thousands of wood buildings, from poorly anchored houses on steep hillsides to multi-story apartment buildings constructed atop weakly braced parking garages, are at risk of collapse from strong ground shaking. Many more wood structures, including most houses, while not collapse hazards, contain design or construction deficiencies which will contribute to an excessive dollar loss the next time a significant earthquake strikes a major city." (CUREE, 1998).

The impending threat of the next damaging earthquake emphasizes the urgent need for woodframe construction research. Earthquakes in the region are inevitable and all are vulnerable. The need for effective earthquake education, coupled to the research, is underscored by the fact that California alone bears three quarters of the national earthquake risk; nearly half of the national risk is located in southern California, with one quarter of the national risk concentrated in Los Angeles County alone (FEMA, 2000). An important note: The region is not unique! Worldwide, about 200 cities with a population of 500,000 or more lie within 100 km of active faults (Sieh, 2000). However, long periods of quiescence in most earthquake-prone regions – sometimes hundreds of years – can transpire between damaging events. This is certainly true in southern California. We are learning that effective communication of earthquake-related information – whether scientific, engineering-based, or safety-oriented – is dependent upon clear answers to some difficult questions, i.e.: How can science- and engineering-based understanding of earthquakes contribute to motivating people to active mitigation and preparation? What are the most effective methods to transfer earthquake-related information? How do we teach people to retain information they will not frequently use? What should children and their families know about earthquake-related science, engineering and safety? The author, with guidance from the Woodframe Project advisory committee and with assistance from partners and volunteers in the community, constructed an education and outreach program designed to address these questions.

2. Earthquake Education via the Museum: A Non-Traditional Method

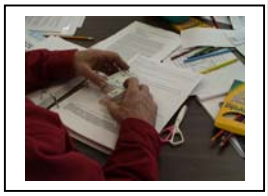
The mission of the exhibit, completed as of January 17, 2002, is to provide positive messages about studying the Earth and preparing our buildings and ourselves for damaging earthquakes. Before entering the design phase of the exhibit, we conducted a review of earthquake education products and programs. We had thought that our schools would be the best place to begin with earthquake education, because there is an obvious link between Earth sciences (a combination of physics, math, and chemistry) and earthquakes. Yet even in California where the risk is so great, there is little time designated by educators to Earth sciences, let alone earthquake engineering or education; and no topics related to earthquakes are included in the California's newest version of its science education standards (de Groot, 2001). The group of partners and volunteers we assembled concluded that the best way to achieve our goal was to work with both educators and a museum – an informal teaching and learning venue. We chose Riverside County Youth Museum (also known as "KidZone") as the pilot location for the exhibit. The museum sits in an ideal location: first, it is visited by some ~20,000 K-6 students per year, bused in from school districts in surrounding counties; second, the community-supported museum boasts a commitment to excellence in providing hands-on, interactive displays and accompanying educational materials to teachers, students and families; and third, the museum is in close proximity to three major southern California faults.

2.1 Partners Form a Focus Group



The planning group envisioned "ShakeZone" (the exhibit's official moniker) as a community resource: a venue for educators, a place for students of all ages; a center for hazards education in southern California; and as a model for similar exhibits. They drew on the expertise of people who live and work in the community: people from nearby institutions and organizations that provided sufficient resources (personnel release time, matching funds, and special gifts) to complete the project. The focus group's task was to aid in developing a storyline, education program, accompanying activities, and feedback mechanisms for assessment. The core focus group included representatives from the National Science Foundation Science and Technology Center's Southern California Earthquake Center (SCEC); KidZone museum administrators, who galvanized local business people to procure and maintain the physical plant; educators from two local universities and an elementary school, who provided science content and pedagogical advice; Consortium of Earthquake Engineering Research Universities (CUREE) Woodframe Mitigation Project management committee and advisory committee members, who reviewed technical plans for construction of most of the museum exhibit displays and signage; and Riverside Police Department's Emergency Services personnel, who shared the perspective of those in emergency services and city planning.

2.2 Exhibit Mission and Content


The exhibit is designed to reach all people in the local community, particularly elementary and secondary school children, with positive messages about studying the Earth and preparing for earthquakes. Other objectives of the exhibit are to provide a global to local perspective of how the Earth changes; to promote empowerment of citizens by providing information and instruction regarding safety and mitigation; and to motivate individuals to be active in hazard preparedness in their local communities.

Visitors to the museum, primarily children, become "seismic sleuths," scientists, engineers, and emergency planners, as they follow the winding path that takes them to each of the three main theme areas of the exhibit. The visitor is on a "mission" to learn as much as possible in order to assist his/her family in the preparation for an earthquake. Taking personal responsibility for safety is the lesson: "I can prepare for earthquakes by learning about how the Earth changes,

what happens to my house and other buildings during earthquakes, and how I can help my family make a safety plan."

All "ShakeZone" activities provided to teachers and museum educator/facilitators are aligned with educational content standards approved by the State of California Department of Education. These include pre- and post-activities featuring a cross-curricular approach; a supporting website; a guidebook to the exhibit; educator/explainer facilitated programs; and professional development programs sponsored by SCEC and CUREE.

2.2.1 Exhibit Components

Exhibit components include interactive displays, such as a series of free-standing models, an earthquake preparedness kit-making venue, and a kiosk with computer simulations, real time earthquake data and information, and educational videos. CUREE, through its Woodframe Mitigation Project, has funded shake table models, architectural models, a Northridge Meadows Apartment complex diorama, full-scale floor models of woodframe structural components, and instructional video footage.




2.2.2 "ShakeZone" Website

The website (http://www.kidzone.org/) is an important component for education and advertising, and is authored by a team of people from SCEC, CUREE and KidZone web authors. It features PowerPoint presentations from contributing organizations, a "virtual tour" of the exhibit itself, links to all sponsors, scanned materials on science, engineering and preparedness, video clips from CUREE, SCEC and other sources, links to online hazard maps, photographs of the displays, and a safety kit preparation page with instructions on how to build your own, along with a list of vendors.

2.2.3 ShakeZone Educational Activities

Drawing from the knowledge that earthquake education should attempt to increase protective actions by people, groups, and institutions by presenting information about the hazard and the risk it poses (Nathe, Gori, Greene, Lemersal, & Mileti, 1999), a series of activities have been developed to accompany the interactive displays in the exhibit. Activities for students of all ages include very short (5-10 minutes) exercises to be led by museum facilitators or teachers and focus on simple concepts about the Earth. Longer activities (15-30 minutes) include Earth science and engineering concepts, how to make an earthquake survival kit, and feature guest speakers from the local community. Half-day or full-day activities include first aid/CPR, lessons from sections of FEMA-159 "Tremor Troop" or FEMA-253 "Seismic Sleuths" curricula, and advanced preparedness training by local emergency managers. Other materials that become

available are procured and used by museum facilitators.

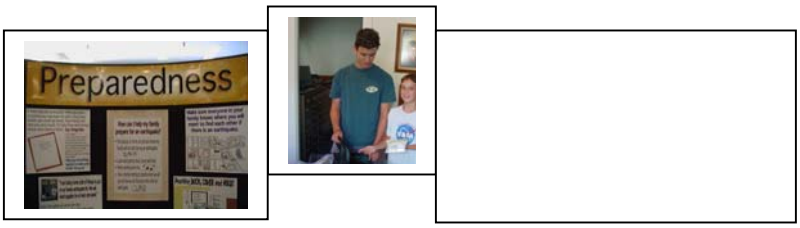
Engineering issues addressed in the exhibit focus on two main areas: the first relates to the engineering educational content covering man-made structures and personal empowerment while the second relates to current design issues. The shake table is placed in an entry point that addresses topics such the effects of shaking on man-made structures, building construction and retrofit techniques, and what individuals can do to improve building safety. Attention is given to fundamental principles such as balance of forces, construction materials and material properties (concrete, wood, steel), structural design features and improvements (trusses, bracing), and methods of constraining objects inside buildings (strapping, securing).

Successful programs offer materials that give people something to think about and also are supported by authorities; further, the information presented in a program must be direct and clear (Nathe et al.). "ShakeZone" creators agree with these concepts and have built into the exhibit ways to transfer information to families about risk and actions they can use to minimize vulnerability. By empowering the museum's most common visitors – children – to learn and act, we are reaching their families, friends and neighbors with the positive messages promoted in the exhibit. The museum offers one way to provide a sustained program that is consistent in its message and mission about earthquake education.

2.2.4 "ShakeZone" Entry Points

"ShakeZone" offers several entry points in order to divide up content areas into manageable chunks for visitors. Educators who have only a limited time or have specific objectives have the option to use only part of the exhibit for their classes. *Entry Point 1* addresses the question, "Where do I live?" by focusing on global to local maps that help visitors identify major landforms and obtain a sense of scale and structure from a qualitative standpoint. *Entry Point 2* addresses the question, "How does the Earth change?" by examining changes on the Earth over geologic time scales, exploring large scale processes (plate tectonics), and showing how the Earth accommodates changes (plate boundary activity, active faults). *Entry Point 3* poses the question, "What happens when the Earth shakes?" Visitors learn about the earthquake process and explore the different kinds of waves produced by the Earth. Video footage of actual earthquakes and activities designed to teach visitors how the waves get from the fault to their location will be part of this section. *Entry Point 4* asks "How do earthquakes affect buildings and other structures?" Visitors learn how shaking affects structures and examine other hazards posed by earthquakes, such as fire, tsunami, liquefaction, etc. They also learn how engineers use devices such as shake tables and computers to simulate earthquakes in order to test structures. They learn about various types of buildings, building materials and construction techniques and will be able to identify what type of structure they live or work in. *Entry Point 5* asks "How can I help my family prepare for an earthquake?" This is the section that emphasizes personal preparedness and empowers individuals to act in their local community. Although the area they live in is vulnerable to earthquakes, there are actions they

can take to protect themselves. They are encouraged to conduct a home hazard "hunt," and learn about how to rearrange nonstructural items inside their homes to make them safer. *Entry Point 6* concludes the tour by asking "What can I do?" Preparation at the home level presented here, with complete instructions on how to make a survival kit.



3. Conclusion

The exhibit's creators understand that changing behavior, especially with events such as earthquakes that seldom occur, is a long process. We have put into place a community-supported educational exhibit that is relevant, helps increase literacy, and promotes empowerment for all its visitors.

Toward that end, both SCEC and CUREE have provided funding and personnel to contribute to the long term sustainability of the exhibit. Since the exhibit is divided into three main sections, any one of those sections can stand alone and thus be transported to another venue. A separate set of posters, which provide a general overview of the exhibit, have been created for smaller venues, such as workshops in other locations or as temporary exhibits at major conferences.

The museum has already hosted a series of training workshops for educators and museum facilitators. These workshops are conducted by SCEC and CUREE, in concert with US Geological Survey personnel from the Western Region Pasadena Office.

A detailed draft report outlining the entire planning process, content of the pedagogical aspects of the exhibit, and additional activities will become available via the "ShakeZone" website. Since the entire exhibit was funded by federal sources, any organization or group of individuals wishing to replicate the exhibit may do so. The full report and all fabrication plans are available for that purpose.

Short term change due to major disasters will always prove to be the most effective; however, we will contribute toward greater understanding and increased safety with programs such as "ShakeZone."

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